CHAPTER 4

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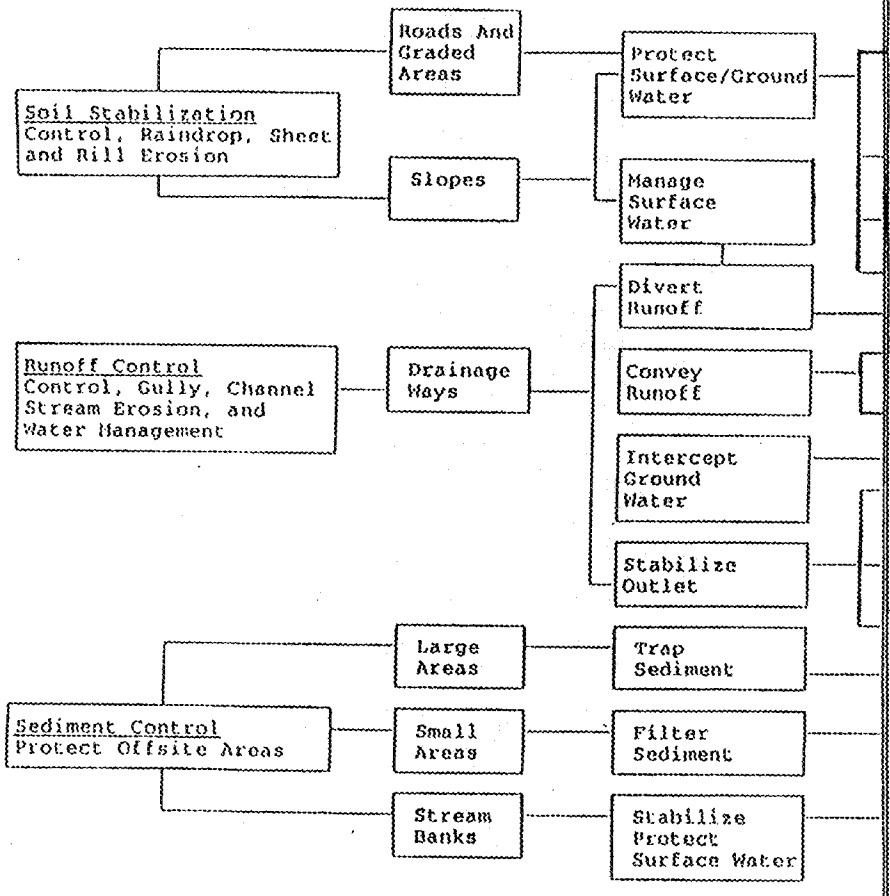
STANDARDS AND SPECIFICATIONS

WATER MANAGEMENT AND SEDIMENT CONTROL BMP SELECTION PROCESS



CONTROL MEASURE GROUP	CONTROL MEASURE	PLAN KEY
Vegetative Soil Cover	Temporary Seeding	TS
	Permanent Seeding	PS
	Sodding	SD
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STEP #1	STEP #2	STEP #3	STEP #4	STEP #5
IDENTIFY THE CONTROL PROBLEM	IDENTIFY PROBLEM AREAS	IDENTIFY STRATEGY	IDENTIFY CONTROL MEASURE GROUP	IDENTIFY SPECIFIC CONTROL MEASURES

"COST SAVING TIPS" FOR BMP SELECTION PROCESS

1. Relate the development to the site conditions, identify and map natural features, such as topography, water areas, drainageways, existing vegetation, depth to rock, floodways, etc. For instance, in site planning consider level areas for building locations and parking areas and steep areas for open space. Locate streets as nearly as possible to the contour, avoiding steep grades.

2. Minimize land grading and develop a plan to fit the existing topography, grade only where necessary. Schedule land-disturbing activities and grade only the smallest practical land area at one time to reduce erosion potential.

3. Integrate surface and stormwater drainage systems to plan for safe disposal of the increased runoff. Keep runoff velocities low; temporarily retain excess runoff on the site to reduce the sediment load.

4. Retain as much existing vegetation as possible, in particular, leave natural buffer zones adjacent to streams, on steep slopes and on other critical erosion areas.

5. Temporary Vegetation should be seeded on disturbed areas if construction is not completed in a short period of time. Annual plants germinate quickly, slow runoff and reduce erosion.

6. Revegetate permanently after final grading and as soon as practical. A dense vegetative cover is the most efficient erosion control.

7. Schedule grading operations and other development activities to reduce time of land exposure. Only grade areas that will be developed immediately.

8. Install diversions, waterways, sediment basins and/or other BMPs beforehand, when removal of vegetation and land grading is necessary or unavoidable.

These erosion and sediment control principles can often prevent a large portion of potential soil loss from the development site and reduce stormwater runoff. As more of these principles are applied, fewer structural BMPs are needed and out-of-pocket costs are reduced.

WATER MANAGEMENT, EROSION AND
SEDIMENT CONTROL FOR CONSTRUCTION AREAS

TECHNICAL STANDARD AND SPECIFICATIONS

Temporary Seeding (TS)

Definition

The establishment of a temporary vegetative cover on disturbed areas by seeding with the appropriate rapid growing plants.

Purposes

1. To reduce the erosion and sedimentation by stabilizing disturbed areas that will not be brought to final grade for a year or less.

2. To reduce problems associated with mud or dust from bare soil surfaces during construction.

3. To reduce sediment runoff to downstream areas and/or groundwater basins and improve the visual resources of the construction area.

Conditions Where Practice Applies

On exposed soil surfaces where additional work (grading, etc.) is not scheduled for a period of three weeks to less than one year.

Planning Considerations

1. Protect the area from excess runoff as necessary with diversions, terraces, or sediment basins.

2. Evaluate the capabilities and limitations of the soil to be seeded. Special attention needs to be given to soil Ph, texture, internal water movement, steepness, and stability in order to plan the appropriate treatment.

3. Plant species should be selected on the basis of quick germination, growth, and time of year to be seeded.

4. Fertilizer, lime, seedbed preparation, seed coverage, mulch, and irrigation should be used as necessary to promote quick plant growth.

Temporary Seeding (Cont'd)

SPECIFICATIONS

I. Site Preparation

A. Grade as needed and feasible to permit the use of conventional equipment for seedbed preparation, seeding, mulch application, and anchoring.

B. Install the needed erosion control practices prior to seeding such as diversions, temporary waterways for diversions outlets, and sediment basins.

II. Seedbed Preparation

A. Lime (in lieu of a soil test recommendation) on acid soil (Ph 5.5 or lower) and subsoil at rate of 150 pounds per 1,000 square feet or two tons per acre of agricultural ground limestone. For best results, make a soil test. This can reduce expense of unneeded lime and fertilizer and potential excess nutrient loss through runoff and leaching.

B. Fertilizer (in lieu of a soil test recommendation) shall be applied at a rate of 28 lbs. per 1,000 square feet or 1,200 lbs. per acre of 10-10-10 analysis or equivalent.

C. Work the lime and fertilizer into the soil with a disk harrow, springtooth harrow, or similar tools to a depth of two inches. On sloping areas, the final operation shall be on the contour.

III. Seeding

A. Species Selection [1 & 3]

March 1 to October 31	Per 1,000 Square Feet	Per Acre
1. Oats	3 lbs.	4 bu.
2. Perennial Ryegrass	1 lb.	40 lbs.
3. Tall Fescue	1 lb.	40 lbs.
4. Wheat	3 lbs.	2 bu.
5. Annual Rye	3 lbs.	2 bu.

Temporary Seeding (Cont'd)

November 1 to February 28 [2]	Per 1,000 Square Feet	Per Acre
1. Annual Rye	3 lbs.	2 bu.
2. Wheat	3 lbs.	2 bu.
3. Perennial Ryegrass	1 lb.	40 lbs.
4. Tall Fescue [4]	1 lb.	40 lbs.

B. Apply the seed uniformly with a cyclone seeder, drill, cultipacker, seeder, or hydroseeder (slurry may include seed and fertilizer) preferably on a firm, moist seedbed. Seed no deeper than one-fourth inch to one-half inch.

C. When feasible, except where a cultipacker type seeder is used, the seedbed should be firmed following seeding operations with a cultipacker, roller, or light drag. On sloping land, seeding operations should be on the contour wherever possible.

IV. Mulching (For complete detail reference "Mulching - Permanent and Temporary (M)")

A. Mulch shall be applied to protect the soil and provide a better environment for plant growth.

B. Mulch shall consist of small grain straw (preferably wheat or rye) and shall be applied at the rate of two tons per acre or 100 pounds (two or three bales) per 1,000 square feet.

C. Spread the mulch uniformly by hand or mechanically so the soil surface is covered. Following application, the mulch shall be anchored or otherwise secured to the ground according to one of the following methods:

1. Mechanical - Use a disk, crimper, or similar type tool set straight to punch or anchor the mulch material into the soil.

2. Mulch Tackifiers/Nettings/Emulsions - Use according to the manufacturer's recommendations. Superior method in areas of water concentration to hold mulch in place.

Temporary Seeding (Cont'd)

3. Wood Fiber - Wood fiber hydroseeder slurries may be used to tack straw mulch. This combination treatment is well suited to steep slopes and critical areas, and severe climate conditions.

V. Irrigation

If soil moisture is deficient, supply new seedings with adequate water for plant growth until they are firmly established. This is especially true when seedings are made late in the planting season, in abnormally dry or hot seasons, or on adverse sites.

[1] / Other seed species may be substituted; check with the local SCS office for recommendation.

[2]/ After November 1, also apply mulch. See Standard and Specifications for Mulching.

[3]/ Clip or otherwise control vegetation as needed near structures to prevent the vegetation from maturing and drying for the purpose of preventing a fire hazard.

[4]/ If Tall Fescue is used as a temporary seeding this may also serve as a permanent seeding depending upon the quality of the stand.

WATER MANAGEMENT, EROSION AND
SEDIMENT CONTROL FOR CONSTRUCTION AREAS

TECHNICAL STANDARD AND SPECIFICATIONS

Permanent Seeding (PS)

Definition

The establishment of permanent vegetation on disturbed areas by planting seed.

Purpose

1. To reduce the erosion and decrease sediment yield from disturbed areas.

2. To permanently stabilize disturbed areas in a manner that is economical, adaptable to site conditions, and allows selection of the most appropriate plant materials.

Conditions Where Practice Applies

1. Disturbed areas where permanent, long-lived vegetative cover is needed to stabilize the soil.

2. Rough graded areas that will not be brought to final grade for several months or more.

Planning Considerations

1. Protect the area from excess runoff - as necessary with diversions, grassed waterways, terraces, or sediment basins.

2. Evaluate the capabilities and limitations of the soil to be seeded. Special attention needs to be given to soil Ph, texture, internal water movement, steepness, and stability in order to plan the appropriate treatment.

3. Plant species should be selected on the basis of timing of establishment, planned use of the area, and the amount or degree of maintenance that can be devoted to the area in the future.

4. Fertilizer, lime, seedbed preparation, seed coverage, mulch, and irrigation should be used as necessary to promote quick plant growth.

5. Vegetation cannot be expected to provide erosion control cover and prevent soil slippage on a soil that is not stable due to its structure, water movement, or excessive slope.

Permanent Seeding (Cont'd)

SPECIFICATIONS

I. Site Preparation

A. Soil material should be capable of supporting permanent vegetation and have at least 25 percent silt and clay to provide an adequate amount of moisture holding capacity. An excessive amount of porous sand will not consistently provide sufficient moisture for good growth regardless of other soil factors.

B. Where compacted soils occur, they should be broken up sufficiently to create a favorable rooting depth of 6-8 inches.

C. Stockpile topsoil to apply to sites that are otherwise unsuited for establishing vegetation.

D. Grade as needed and feasible to permit the use of conventional equipment for seedbed preparation, seeding, mulch application and anchoring, and maintenance. After the grading operation, spread topsoil where needed.

E. Install the needed erosion control practices such as diversions, grassed waterways, and sediment basins.

II. Seedbed Preparation

A. Lime (in lieu of a soil test recommendation) on acid soil and subsoil, 150 pounds per 1,000 square feet or three tons per acre of agricultural ground limestone. For best results, make a soil test. This can reduce expense of unneeded lime and fertilizer and potential excess nutrient loss through runoff and leaching.

B. Fertilizer (in lieu of a soil test recommendation) apply 28 pounds per 1,000 square feet or 1,200 pounds per acre of 10-10-10 analysis. For best results, make a soil test.

C. Work the lime and fertilizer into the soil with a disk harrow, springtooth harrow, or other suitable field equipment to a depth of 4 inches. On sloping land, the final operation shall be on the contour.

Permanent Seeding (Cont'd)

III. Seeding

A. Select a species or mixture appropriate for the site.

1. Permanent Seeding

Kind of Seed[1]	Seeding Dates[2]	Per 1,000 Sq. Ft.	Per Acre
a) Creeping Red Fescue, PLUS Domestic Ryegrass PLUS Kentucky Bluegrass	March-May 15 Aug.-Oct. 15	1/2 lb. 1/4 lb. 1/2 lb.	20 lbs. 10 lbs. 20 lbs.
b) Tall Fescue	March-May 15 Aug.-Oct. 15	1 lb.[3]	40 lbs.
c) Dwarf (Turf-type) Fescue[4]	March-May 15 Aug.-Oct. 15	1 lb.[3]	40 lbs.

2. Special Seedings - Steep Banks or Cuts

Kind of Seed[1]	Seeding Dates[2]	Per 1000 Sq. Ft.	Per Acre
a) Tall Fescue	March-May 15 Aug.-Oct. 15	1 lb.	40 lbs.
b) Crownvetch PLUS Tall Fescue	March-May 15 Aug.-Sept. 15	1/4 lb. 2/3 lb.	10 lbs. 30 lbs.
c) Flatpea PLUS Tall Fescue	March-May 15 Aug.-Sept 15	2/3 lb. 1/2 lb.	30 lbs. 20 lbs.

3. Waterways and Road Ditches

a) Tall Fescue	March-May 15 Aug.-Oct. 15	1 lb.	40 lbs.

IV. Mulching (for complete detail reference "Mulching - Permanent and Temporary (M)")

A. Mulch shall be applied to protect the soil and provide a better environment for plant growth.

Permanent Seeding (Cont'd)

B. Mulch shall consist of small grain straw (preferably wheat or rye) and shall be applied at the rate of two tons per acre or 100 pounds (two or three bales) per 1,000 square feet.

C. Spread the mulch uniformly by hand or mechanically so the soil surface is covered. Following application, the mulch shall be anchored or otherwise secured to the ground according to one of the following methods:

1. Mechanical - Use a disk, crimper, or similar type tool set straight to punch or anchor the mulch material into the soil.

2. Mulch Tackifiers/Nettings/Emulsions - Use according to the manufacturer's recommendations. Superior method in areas of water concentration to hold mulch in place.

3. Wood Fiber - Wood fiber hydroseeder slurries may be used to tack straw mulch. This combination treatment is well suited to steep slopes and critical areas, and severe climate conditions.

V. Maintenance

Maintenance is a vital factor in maintaining an adequate vegetative erosion control cover. See Table 1.

A. Irrigation - If soil moisture is deficient, supply new seedings with adequate water for plant growth until they are firmly established. This is especially true when seedings are made late in the planting season, in abnormally dry and hot season, or on adverse sites.

Permanent Seeding (Cont'd)

B. Repairs - Inspect all seeded areas for failures and make necessary repairs, replacements, reseedings, and remulching within the planting season.

1. If stand is inadequate, (less than 85 percent groundcover) overseed, fertilize, using half of rates originally applied, and mulch.

2. If stand is more than 60 percent damaged, reestablish following original seedbed preparation methods, seeding and mulching recommendations and apply lime and fertilizer as needed according to a soil test.

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[1] Other seed species may be substituted for these mixtures. Check with local SCS office for recommendations.

[2] These seeding dates are ideal. With the use of mulch and irrigation, seedings could be made any time throughout the growing season.

[3] The seeding rates need to be increased two to three times if the mixture is to be used as a lawn.

[4] The dwarf or turf-type fescues are much shorter and have finer leaves than the tall fescues. It is much better suited for lawn-type areas than tall fescues.

TABLE 1

Maintenance Fertilization and Mowing for Permanent Seeding

Mixture	Fertilizer Rate [1] Formula	Lbs. Ac.	Lbs./1000 Sq. Ft.	Time	Mowing
Creeping Red Fescue Ryegrass Kentucky Bluegrass	10-10-10	500	12	Fall Yearly or as needed.	Not Closer than 3".
Tall Fescue	10-10-10	500	12	Fall Yearly or as needed.	Not Closer than 4".
Dwarf (Turf-type) Fescue	10-10-10	500	12	Fall Yearly or as needed.	Not Closer than 2".
Flatpea and Crownvetch with Fescue	0-20-20	400	10	Spring Yearly following establishment and every 4-7 years thereafter.	Do Not mow.

[1]/ In lieu of soil test.

WATER MANAGEMENT, EROSION AND
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TECHNICAL STANDARD AND SPECIFICATIONS

Sodding (SO)

Definition

Stabilizing fine-graded disturbed areas by establishing permanent grass stands with sod.

Purpose

1. To establish permanent turf immediately.

2. To prevent erosion and damage from sediment and runoff by stabilizing the soil surface.

3. To reduce the production of dust and mud associated with bare soil surfaces.

4. To stabilize drainageways where concentrated overland flow will occur.

Conditions Where Practice Applies

1. Disturbed areas that require immediate vegetative covers or where sodding is preferred to other means of grass establishment.

2. Locations particularly suited to stabilization with sod are:

   -waterways carrying intermittent flow
   -area around drop inlets in grassed swales
   -residential or commercial lawns where aesthetics are a primary factor.

Planning Considerations

1. Protect the area from excess runoff as necessary with appropriate BMPs (diversions, grass waterways, terraces, or sediment basins).

2. Evaluate the capabilities and limitations of the soil to be sodded. Special attention should be placed on soil Ph, texture, internal water movement, steepness, and stability in order to plan the appropriate treatment.

3. The species of sod selected should be based on soil type, planned use of the area, and the amount of maintenance that can be devoted to the area in the future.

Sodding (Cont'd)

4. Fertilizer, lime, seedbed preparation, and irrigation should be used as necessary to promote quick establishment.

5. Sod cannot be expected to provide erosion control and prevent soil slippage on a soil that is not stable due to its structure, water movement, or excessive slope.

SPECIFICATIONS

I. Site Preparation

A. Soil material shall be capable of supporting permanent vegetation and shall consist of at least 25 percent silt and clay to provide an adequate amount of moisture holding capacity. An excessive amount of porous sand will not consistently provide sufficient moisture for the sod regardless of other soil factors.

B. Compacted soils must be broken up sufficiently to create a favorable rooting depth of 6-8 inches.

C. Stockpile topsoil to apply to sites that are otherwise unsuited for establishing vegetation.

D. Grade as needed and feasible to permit the use of conventional equipment for sodbed preparation. After the grading operation, spread topsoil where needed.

II. Sodbed Preparation

A. Lime (in lieu of a soil test) on acid soil and subsoil apply 100 pounds per 1,000 square feet or two tons per acre of agricultural ground limestone or equivalent. For best results, make a soil test. This can reduce expense of unneeded lime and fertilizer and potential excess nutrient loss through runoff and leaching.

B. Fertilizer (in leu of a soil test) apply 28 pounds per 1,000 square feet or 1,200 pounds per acre of 10-10-10 analysis. For best results, make a soil test.

C. Work lime and fertilizer into the soil with a disk harrow, springtooth harrow, or other suitable field equipment to a depth of four inches.

D. Prior to sodding, the soil surface shall be cleared of all trash, debris, and stones larger than one and one-half inches in diameter, and of all roots, brush, wire, and other objects that would interfere with the placing of the sod.

Sodding (Cont'd)

E. After the lime and fertilizer have been applied and just prior to the laying of the sod, the soil in the area to be sodded shall be loosened to a depth of one inch. The soil shall be thoroughly dampened immediately after the sod is laid if it is not already in a moist condition.

III. Cutting and Handling of Sod

A. The sod should consist of strips of live, vigorously growing grasses. The sod should be free of noxious and secondary noxious weeds and should be obtained from good, solid, thick-growing stands. The sod should be cut and transferred to the job in as large continuous pieces as will hold together and are practical to handle.

The sod shall be cut with smooth clean edges and square ends to facilitate laying and fitting. The sod shall be cut to a uniform thickness of not less than three-fourth inch measured from the crown of the plants to the bottom of the sod strips for all grasses except bluegrass. Bluegrass sod shall be cut to a uniform thickness of not less than one and one-half inches.

The sod shall be mowed to a height of not less than two inches and no more than four inches prior to cutting.

The sod shall be kept moist and covered during hauling and preparation for placement on the sodbed.

IV. Placing of Sod

A. No sod shall be placed when the temperature is below 32°F. No frozen sod shall be placed nor shall any sod be placed on frozen soil. When sod is placed between the periods of June 15 and September 1 and between the periods of October 15 and March 1, it shall be covered immediately with a uniform layer of straw mulch approximately one-half inch thick or so the green sod is barely visible through the mulch.

Sod shall be carefully placed and pressed together so it will be continuous without any voids between the pieces. Joints between the ends of strips shall be staggered. The edge of the sod at the outer edges of all gutters shall be sufficiently deep so that the surface water will flow over onto the top of the sod.

Sodding (Cont'd)

On gutter and channel sodding, the sod should be carefully placed on rows or strips at right angles to the centerline of the channel (i.e., at right angles to the direction of flow). On steep graded channels, each strip of sod shall be staked with at least two stakes not more than 18 inches apart. The stakes shall be wood and shall be approximately 1/2" X 3/4" X 12". They shall be driven flush with the top of the sod and with the flat side against the slope.

On slopes 3:1, or steeper, and where drainage into a sod gutter or channel is one-half acre or larger, the sod shall be rolled or tamped and then chicken wire, jute, or other netting pegged over the sod for protection in the critical areas. The netting and sod shall be staked with at least two stakes not more than 18 inches apart.

The stakes shall be wood and be approximately 1/2" X 3/4" X 12 ". They shall be driven with the flat side against the slope and on an angle toward the slope. The netting shall be stapled on the side of each stake within two inches of the top of the stake. The stake should then be driven flush with the top of the sod.

The sod shall be tamped or rolled after placing and then watered. Watering shall consist of a thorough soaking of the sod and of the sodbed to a depth of at least 4 inches. The sod should be maintained in a moist condition by watering for a period of 30 days.

Any areas disturbed so as to destroy present seedlings along the edge of the sodbed should be reseeded and mulched as specified in the Permanent Seeding Standard and Specifications.

V. Operation and Maintenance

Where sodding does not establish properly, the area should be sodded again as soon as possible. The cause of the failure should be ascertained and corrected as soon as possible. Physical conditions such as soil conditions may be unfavorable, resulting in the failure, and may require an alternative approach and/or type of cover.

Sodding (Cont'd)

Areas requiring resodding should be prepared in the same manner as the original installation.

Once established, a regular maintenance program for fertilization and mowing of grasses should be performed.

WATER MANAGEMENT, EROSION AND
SEDIMENT CONTROL FOR CONSTRUCTION AREAS

TECHNICAL STANDARD AND SPECIFICATIONS

(Ground Covers) (GC)

Definition

Stabilizing disturbed areas by establishing vegetative cover with ground covers, trees, shrubs, or vines.

Purposes

1. To aid in stabilizing soil in areas where vegetation other than turf is preferred.

2. To provide food and shelter for wildlife where wildlife habitat is desirable.

Conditions Where Practice Applies

1. On steep or rocky slopes, where mowing is not feasible.

2. Where ornamentals are desirable for landscaping purposes.

3. In shady areas where turf maintenance is difficult.

4. Where woody plants are desirable for soil conservation and establish wildlife habitat.

Planning Considerations

1. Protect the area from excess runoff as necessary with diversions, grass waterways, terraces, or sediment basins.

2. Evaluate the capabilities and limitations of the soil to be planted. Special attention should be placed on soil Ph, texture, internal water movement, steepness, and stability in order to plan the appropriate treatment.

3. The species and type of plant selected should be based on soil type, planned use of the area, and the amount of maintenance that can be devoted to the area in the future.

4. Fertilizer, lime, seedbed preparation, and irrigation should be used as necessary to promote quick establishment.

Using Ground Covers, Etc. (Cont'd)

5. Plantings cannot be expected to provide erosion control and prevent soil slippage on a soil that is not stable due to its structure, water movement, or excessive slope.

6. Ground covers are not necessarily low-maintenance plants, although some of them are. In general, they are more difficult to establish than turf. Plants included in this list respond favorably to positive treatment during the period of establishment.

SPECIFICATIONS

I. Planting Time:

A. Early spring if possible, but no later than May 1, for bare root stock. This allows for the maximum root and top development to reduce soil erosion and allow the plant to become established before winter. Later plantings can be made using potted stock.

II. Soil Preparation:

A. For short slopes, small areas, and mass plantings of close spacing apply a commercial granular fertilizer, such as 5-10-10, and organic supplement, such as composted cow manure, peat, or well-rotted sawdust, and work into the soil prior to planting. Fertilize with 30-50 pounds per 1,000 square feet. The organic material needed will depend upon the soil and plant being used. Plants such as pachysandra require a high rate of organic material, about a 2-inch layer worked into the root zone. Depending on the type and steepness of slope, the depth of soil preparation will vary from 4-6 inches.

B. For steep slopes and large area plantings, working up the entire planting area would be impractical and would probably induce erosion. Center hole planting, a hole dug for each plant would be more desirable. If the soil on the slope is poorly suited to the species being planted, incorporate organic material into the planting hole. Whether organic material is needed of not, fertilize each plant at the rate of one ounce per plant of a complete fertilizer such as 10-10-10. Mix fertilizer with soil below the roots of the plants or place slow-release pellet or packet in bottom of planting hold.

Using Ground Covers, Etc. (Cont'd)

C. Another alternative is to add to the planting hold a sandy loam soil mixed with peat, composted cow manure, or well-rotted sawdust at a rate of 1:1 or 1:2.

D. The entire planted slope should be covered with a protective mulch, such as straw, wood chips, or wood pulp fiber, to conserve moisture and control soil erosion. Weeds should be controlled.

E. Where erosion hazard is very high, jute matting or fiberglass matting (for complete detail reference "Mulching - Permanent and Temporary (M)") stapled to the slope will provide excellent soil erosion control.

III. Establishment:

A. Some watering, weeding, remulching, and fertilizing may be required of a new planting during the period of establishment. Soil movement is not recommended. This could cause soil erosion and/or root injury. Competing weeds should be controlled.

B. If a controlled-release fertilizer was used at the time of planting, additional fertilizing will not be necessary for several years. Otherwise, fertilize plantings in the spring of the second growing season and thereafter as needed, using 2 to 3 pounds per 100 square feet of a granulated commercial fertilizer such as 5-10-10.

IV. Planting:

Select the desired type and species of plants based on the suitability of the soil, the planned use, and the characteristics of the site. Refer to Appendix C to select the species best suited. Appendix C lists some plants known to be suitable for soil erosion control and possessing aesthetic and wildlife habitat value. This list is neither inclusive nor exclusive. The list includes plants that establish easily on difficult sites, as well as plants that will require some site improvement before they grow satisfactorily.

A. Ground Covers - Ground covers are best planted in spring. Container-grown plants can be planted throughout the growing season if adequate water is provided.

Using Ground Covers, Etc. (Cont'd)

Site Preparation - Ground covers are plants that naturally grow very close together, causing severe competition for space, nutrients, and water. Soil for ground covers should be well prepared. A well-drained soil high in organic matter is best.

If the area to be planted is so large that adding amendments to the soil as a whole would be impractical, organic matter may be added only to each planting hole.

Plants such as ivy, pachysandra, and periwinkle should be planted on one-foot centers; large plants such as juniper can be spaced on three-foot center.

Mulching - The soil between trees and shrubs must be planted with cover vegetation or must be mulched. When establishing ground covers, it is not desirable to plant species that will make maintenance difficult. A thick durable mulch such as shredded bark or wood chips is recommended to prevent erosion and reduce weed problems. Pre-emergent herbicides may be necessary where weeding is not practical.

On slopes where erosion may be a problem, jute net or excelsior blankets may be installed prior to planting, and plants tucked into the soil through slits in the net. Such plants should be put in a staggered pattern to minimize erosion.

Maintenance - Trim old growth as needed to improve the appearance of ground covers. Most covers need once-a-year trimming to promote growth. Maintain mulch cover with additions of mulch where needed.

B. Shrubs and Trees

Planting Bare-Rooted Tree and Shrub Seedlings

WHEN - Trees to be planted as bare-rooted (without soil attached) seedlings should be handled only while dormant in spring.

When planting, roots must be kept moist until trees are in the ground. Do not carry seedlings in your hand exposed to the air and sun. Keep moss-paced seedlings in a container packed with moss or filled with thick muddy water. Cover clay-treated seedlings with wet burlap only.

Using Ground Covers, Etc. (Cont'd)

Bare-root stock shall be planted vertically and not at an angle. The roots shall be planted as deep or slightly deeper than planted originally. Take special care not to bend the main root when planting. Firm the soil around the seedling after planting.

When stabilizing the disturbed area between tree plantings, do not use grasses or legumes that will overshade the new seedlings. Where possible, a circle of mulch around seedlings will help them to compete successfully with herbaceous plants.

Transplanting Trees (Plant Balled and Burlapped and Container-Grown Trees

WHEN - Spring is preferred for deciduous trees (hardwoods) and early fall (August-September) for evergreens.

Tree Preparation - Proper digging of a tree includes saving as much of the root system as possible, particularly the fine roots. Soil adhering to the roots should be damp when the tree is dug and kept moist until planting. The soil ball should be 12 inches in diameter for each inch of diameter of the trunk. The tree should be carefully excavated, and the soil ball wrapped in burlap and tied with rope. Use of a mechanical tree spade is also acceptable.

Evergreens, or any trees that are to be transplanted for a distance, should have the branches bound in with soft rope to prevent damage.

Site Preparation - The planting hole should be dug deep and wide enough to allow soil to be placed all the way around root ball. The final level of the root ball's top should level with the ground surface.

As the hole is dug, topsoil should be kept separate from subsoil. If possible, discard subsoil and replace with good topsoil. If topsoil is unavailable, improve subsoil by mixing in 1/3 by volume of peat moss or well-rotted manure.

Using Ground Covers, Etc. (Cont'd)

Heavy or poorly drained soils are less desirable growth media for trees. When it is necessary to transplant trees into such soils, drainage may be needed. Properly installed drain tile will improve drainage. Also, tree species that are best suited to heavy or poorly drained soils should be planted.

Setting the Tree - Depth of planting must be close to the original depth. The tree may be set just a few inches higher than in its former location, especially if soil is poorly drained. DO NOT set the tree lower than before. Soil to be placed around the root ball should be moist but not wet.

Set the tree in the hole and remove the rope that holds the burlap. Loosen the burlap; remove completely if that is practical. Do not break the soil of the root ball. Fill the hole around the tree with soil half-way, and tamp firmly around the root ball. Add water to settle the soil and eliminate air pockets. When the water has drained off, fill the hole the remainder of the way and tamp as before.

Use extra soil to form a shallow basin around the tree, somewhat smaller than the diameter of the root ball (Plate 1.80e). This will be for holding water when the tree is irrigated. Note: Level the ground and eliminate these basins when winter sets in, as ice forming in the basin might injure the trunk.

Supporting the Tree - Newly planted trees need artificial support to prevent excessive swaying. Stakes or guy wires may be used. Remove artificial supports after the tree is established.

Watering - Soil around the tree should be thoroughly watered after the tree is set in place. When the soil becomes dry, the tree should be watered deeply but not too often. Mulching around the base of the tree is helpful in preventing roots from drying out.

Maintenance of Tree and Shrub Plantings

Like all plants, trees require water and fertilizer to grow. Ideally, young trees should receive an inch of water each week for the first two years after planting. When rain does not supply this need, the tree should be watered deeply but no more than once per week.

Using Ground Covers, Etc. (Cont'd)

Transplanted trees should be fertilized one year or so after planting. There are many sophisticated ways to supply fertilizer to trees, but some simple methods are adequate. The best material for small trees is well-rotted manure, if it can be obtained. Add it as a 2-inch layer of mulch around the tree annually. If chemical fertilizers are to be used, a formulation such as 10-8-6 or 10-6-4 is preferred. Use about 2 lbs. per inch of trunk diameter measured 4 feet from the ground. Thus, if the trunk diameter at 4 feet was 5 inches, 10 lbs. of fertilizer would be applied.

Note: Evergreens - use 1/2 the recommended amount of chemical fertilizer or use only organic fertilizers such as cottonseed meal, bone meal, or manure.

Fertilizer must come in contact with the roots to benefit the tree. A simple way to ensure this is to make holes in the tree's root area with a punchbar, crowbar, or auger. Holes should be 18 inches deep, spaced about 2 feet apart, and located around the drip line of the tree. Distribute the necessary fertilizer evenly into these holes, and close the holes with the heel of the shoe or by filling with topsoil or peat moss. Fertilize trees in late fall or in early spring before leaves emerge.

WATER MANAGEMENT, EROSION AND
SEDIMENT CONTROL FOR CONSTRUCTION AREAS

TECHNICAL STANDARD AND SPECIFICATIONS

Mulching - Permanent and Temporary (M)

Definition

The application of plant residues and other suitable materials to the soil surface.

Purpose

1. To prevent erosion by protecting the soil surface from raindrop impact and reducing the velocity of overland flow.

2 To foster the growth of vegetation by increasing available moisture and providing insulation against extreme heat and cold.

3. To improve the aesthetics of the site and reduce weed competition.

Conditions Where Practice Applies

Temporary Mulches

1. Areas that have been seeded to a temporary or permanent seeding.

2. For mud and dust control.

Permanent Mulches

1. Used together with planting trees, shrubs, and other ground covers that do not provide adequate soil stabilization.

2. Used in lieu of vegetation planting for ornamental reasons or because the site is not suitable for vegetation.

Planning Considerations

1. A surface mulch is an effective means of controlling runoff and erosion on disturbed lands.

2. The choice of materials for mulching shall be based on the type of soil to be protected, site conditions, season, and economics.

Mulching - Permanent and Temporary (Cont'd)

3. Organic mulch materials such as straw, wood chips, bark, recycled paper and wood fiber have been found to be the most effective.

4. Chemical soil stabilizers or soil binders/tackifiers/emulsions are not effective mulches when used alone. These materials are useful to bind organic mulches together.

5. A variety of mulch nets and mats are available to use as mulching or to hold the mulch in place. Netting and mats are especially helpful on critical areas such as waterways. (For complete detail reference "Mulching - Permanent and Temporary (M)").

Organic Mulches

Straw - The mulch most commonly used in conjunction with seeding. The recommended straw should come from wheat, rye or barley and may be spread by hand or machine. Straw can be windblown and should be anchored to stay in place.

Wood Chips - Suitable for areas that will not be closely mowed, and around ornamental plantings. Chips decompose slowly and do not require tacking. Should be treated with 12 pounds slow-release nitrogen per ton to prevent nutrient deficiency in plants. Can be a very inexpensive mulch if chips are obtained from trees cleared on the site.

Bark Chips, Shredded Bark - By-products of timber processing. Used in landscaped plantings. Bark is also a suitable mulch for areas planted to grasses and not closely mowed; may be applied by hand or mechanically. Bark is not usually toxic to grasses or legumes, and additional nitrogen fertilizer is not required.

Manufactured Wood Fiber and Recycled Paper - Manufactured and sold as mulch materials. Usually marketed to apply in a hydroseeder slurry with binder/tackifiers. Follow manufacturer's recommendations during application.

There are other organic materials that make excellent mulches but are only available locally or seasonally. Creative use of these material can reduce costs.

Mulching - Permanent and Temporary (Cont'd)

Chemical Mulches and Soil Binders

A wide range of synthetic, spray-on materials are marketed to stabilize and protect the soil surface. These are emulsions or dispersions of vinyl compounds, asphalt, rubber, or other substances that are mixed with water and applied to the soil They may be used alone or may be used to tack wood fiber hydromulches or straw.

When used alone, chemical mulches do not have the capability to insulate the soil or retain soil moisture that organic mulches have. This soil protection is also damaged by traffic. Application of these mulches is usually more expensive than organic mulching, and the mulches decompose in 60-90 days.

Nets and Mats

Netting can help retain soil moisture or modify soil temperature. It stabilizes the soil surface while grasses are being established and is particularly useful in grassed waterways and on slopes. Lightweight netting may also be used to hold other mulches in place.

The most critical aspect of installing nets and mats is obtaining firm, continuous contact between the material and the soil. Without such contact, the material is useless and erosion occurs. It is important to use an adequate number of staples and to roll (compress) the material after laying it to ensure that the soil is protected.

Aggregate Cover

Gravel and crushed stone provide a long-term protection against erosion, particularly on short slopes. Before the gravel or crushed stone is applied it should be washed. If vegetation is not desired, black polyethylene sheeting should be placed on the ground first to prevent seed germination and growth through the aggregate cover.

Mulching - Permanent and Temporary (M) (Cont'd)

SPECIFICATIONS

ORGANIC MULCHES

Materials: Select mulch material based on site requirements, availability of materials, and availability of labor and equipment. The following are the minimum rates:

Mulch	Rate Per Acre	Rate Per 1000 Ft.	Notes
1. Straw (Temporary Only)	2 tons	90 lbs.	Free from weeds and coarse matter. Should be anchored. Spread with mulch blower or by hand.
2. Wood Chips (Permanent) or (Temporary)	400 yds.	9-10 yds.	Apply approximately 3 inches deep. Treat with 12 lbs. of nitrogen per ton. Do not use on firm turf areas. Apply with mulch blower, chip handler, or by hand.
3. Paper (Recycled Newsprint) 50 lbs./100 Gal. Water (Temporary Only)			Rate of application may vary according to manufacturer's recommendations and model of hydroseeder in use.
4. Wood Fiber 50 lbs./100 Gal. Water (Temporary Only)			Rate of application may vary according to the manufacturer's recommendations and model of hydroseeder in use.
5. Bark Chips or Shredded Bark (Temporary Only)	70 yds.	1-1/2-2 yds.	Apply about 1/2 inch thick. Apply with a mulch blower or by hand.

Mulching - Permanent and Temporary (M) (Cont'd)

6. Gravel or Crushed Stone (Permanent)	400 yds.	9-10 yds.	Apply approximately 3 inches deep. Apply with mechanical equipment or by hand.

Prior to Mulching: Complete the required grading and install needed sediment control practices.

Lime and Fertilizer: Should be incorporated and surface roughening accomplished as needed. Seed should be applied prior to mulching except where seed is to be applied as part of a hydroseeder slurry containing mulch.

Application: Mulch materials shall be spread uniformly, by hand or machine.

When spreading straw mulch by hand, divide the area to be mulched into approximately 1,000 sq. ft. sections and place approximately 90 lbs. of straw in each section to facilitate uniform distribution.

Mulch Anchoring: Mulch shall be anchored during or immediately after spreading to prevent being blown by the wind. One of the following methods of anchoring mulch shall be used: (Method may vary by type of mulch used and manufacturer's recommendations.)

1. Mulch anchoring tool: This is a tractor-drawn implement (mulch crimper, serrated straight disk, or dull farm disk) designed to punch mulch approximately 2 inches into the soil surface. This method provides maximum erosion control with straw. It is limited to use on slopes no steeper than 3:1, where equipment can operate safely. Machinery shall be operated on the contour. (Used mainly for straw)

2. Liquid mulch binders/tackifiers: Applying mulch and binder/tackifiers together is the most effective method. Application of liquid mulch binders and tackifiers should be heaviest at around the edges of areas and at crests of ridges and banks, to prevent windblow. The remainder of the area should have binder/tackifiers applied uniformly. Binders and tackifier may be applied after mulch is spread; however, they are recommended to be sprayed into the mulch as it is being blown onto the soil.

Mulching - Permanent and Temporary (M) (Cont'd)

The following types of binders/tackifiers may be used:

a. Asphalt - Any type of asphalt thin enough to be blown from spray equipment is satisfactory. Recommended for use are rapid curing (RC-70, RC-250, RC-800), medium curing (MC-250, MC-800) and emulsified asphalt (SS-1, MS-2, RS-1, and RS-2).

   Apply asphalt at (4 gal./1,000 ft., 160 gal./acre). Do not use heavier applications as it may cause the straw to "perch" over rills. All asphalt designations are from the Asphalt Institute Specifications.

b. Synthetic Binders - Chemical binders/tackifiers/emulsions may be used as recommended by the manufacturer to anchor mulch. These are expensive and, therefore, usually used in small areas or in residential areas where asphalt may be a problem.

c. Wood Fiber - Wood fiber hydroseeder slurries may be used to tack straw mulch. This combination treatment is well suited to steep slopes and critical areas, and severe climate conditions.

3. Mulch Nettings - Lightweight plastic, cotton, or paper nets may be stapled over the mulch according to manufacturer's recommendations. (See NETS AND MATS, below).

4. Peg and Twine - Because it is labor-intensive, this method is feasible only in small areas where other methods cannot be used. Drive 8-to 10-inch wooden pegs to within 3 inches of the soil surface, every 4 feet in all directions. Stakes may be driven before or after straw is spread. Secure mulch by stretching twine between pegs in a criss-cross-within-a-square pattern. Turn twine 2 or more times around each peg.

CHEMICAL MULCHES

Chemical mulches may be used alone only in the following situations:

1. Where no other mulching material is available.

Mulching - Permanent and Temporary (M) (Cont'd)

2. In conjunction with temporary seeding during the times when mulch is not required for that practice.

Note: Chemical mulches may be used to bind other mulches or with wood fiber in hydroseeded slurry at any time. Manufacturer's recommendations for application of chemical mulches shall be followed.

NETS AND MATS

Net should be used in conjunction with an organic mulch such as straw or wood fiber, etc. Netting should be installed immediately following the application and spreading of the mulch.

The net should be installed over the mulch except when the mulch manufacturer recommends otherwise.

Excelsior blankets and mats with mulch are considered protective mulches and may be used alone on erodible soils and during all times of year.

All products designed to control erosion shall conform to manufacturer's specification and should be applied in accordance with manufacturer's instructions provided those instructions are at least as stringent as this specification.

Staples will be made of plain iron wire, No. 8 gauge or heavier, and will be 6 inches or more in length.

Prior to installation:

1. Shape and grade as required the waterway, channel, slope, or other area to be protected.

2. Remove all rocks, clods, or debris larger than 2 inches in diameter that will prevent contact between the net and the soil surface.

3. When open-weave nets are used, lime, fertilizer, and seed should be applied before laying the net. When excelsior matting is used, lime, fertilizer, and seed must be applied before the mat is laid.

Mulching - Permanent and Temporary (M) (Cont'd)

Laying the Net:

1. Start laying net from top of channel or top of slope and unroll down-grade.

2. Allow to lay loosely on soil--do not stretch.

3. To secure net: Upslope ends of net should be buried in a slot or trench no less than 6 inches deep. Tamp earth firmly over net. Staple the net every 12 inches across the top end.

   Edges of net shall be stapled every 3 feet. Where two strips of net are laid side by side, the adjacent edges shall be overlapped 3 inches and stapled together.

Staples shall be placed down the center of net strips at 3-foot intervals. DO NOT STRETCH net when applying staples.

Joining Strips: Insert new roll of net in trench, as with upslope ends of net. Overlap the end of the previous roll 18 inches, turn under 6 inches, and staple across end of roll just below anchor slot and at the end of the turned-under net every 12 inches.

At Bottom of Slopes: Lead net out onto a level area before anchoring. Turn ends under 6 inches, and staple across every 12 inches.

Check Slots: On highly erodible soils and on slopes steeper than 4:1, erosion check slots should be made every 15 feet. Insert a fold of net into a 6-inch trench and tamp firmly. Staple at 12-inch intervals across the downstream portion of the net.

Mats: Several types of erosion control mats are available. Most mats provide excellent erosion control in areas of concentrated flow in addition to other areas requiring mulch. Mats will vary in strength and composition and the manufacturer's recommendations should be followed in all cases to assure that correct types and installation methods are applied.

WATER MANAGEMENT, EROSION AND
SEDIMENT CONTROL FOR CONSTRUCTION AREAS

TECHNICAL STANDARD AND SPECIFICATIONS

Riprap (RR)

Definition

A permanent, erosion-resistant ground cover of large, loose, angular stone.

Purpose

1. To protect the soil surface from the erosive forces of concentrated runoff.

2. To slow the velocity of concentrated runoff while enhancing the potential for infiltration.

3. To stabilize slopes with seepage problems and/or non-cohesive soils.

Conditions Where Practice Applies

To sites that soil-water interfaces where the soil conditions, water turbulence and velocity, expected vegetative cover, etc., are such that the soil may erode under the design flow conditions. Riprap may be used, as appropriate, at storm drain outlets, on channel banks and/or bottoms, roadside ditches, drop structures, at the toe of slopes, etc.

Planning Considerations

Grades vs. Uniform Riprap

Riprap is classified as either graded or uniform. A sample of graded riprap would contain a mixture of stones that vary in size from small to large. A sample of uniform riprap would contain stones that are all fairly close in size.

For most applications, graded riprap is preferred to uniform riprap. Graded riprap forms a flexible self-sealing cover, while uniform riprap is more rigid and cannot withstand movement of the stones. Graded riprap is cheaper to install, requiring only that the stones be dumped so that they remain in a well-graded mass. hand and mechanical placement of individual stones is limited to that necessary to achieve the proper thickness and line. Uniform riprap requires placement in a more or less uniform pattern, requiring more hand or mechanical labor.

Riprap (RR) (Cont'd)

Riprap sizes can be designated by either the diameter or the weight of stones. It is often misleading to think of riprap in terms of diameter, since the stones should be rectangular instead of round.

However, it is simpler to specify the diameter of an equivalent size of spherical stone. Table 1 lists some typical stones by weight, spherical diameter and the corresponding rectangular dimensions. These stone sizes are based upon an assumed specific weight of 165 lbs./ft.^{3}

SIZE OF RIPRAP STONES
TABLE 1

Weight (lbs.)	Mean Spherical Diameter (ft.)	Rectangular Shape Length (ft.)	Width, Height (ft.)
50	0.8	1.4	0.5
100	1.1	.75	0.6
150	1.3	2.0	.67
300	1.6	2.6	0.9
500	1.9	3.0	1.0
1,000	2.2	3.7	1.25

Since graded riprap consists of a variety of stone sizes, a method is needed to specify the size range of the mixture of stone. This is done by specifying a diameter of stone in the mixture for that some percentage, by weight, will be smaller. For example, D_{85} refers to a mixture of stones in that 85 percent of the stone by weight would be smaller than the diameter specified. Most designs are based on D_{50}. In other words, the design is based on the average size of stone in the mixture. Table 2 lists typical material specifications for graded riprap by diameter and weight of the stone.

TABLE 2

Size Inches	% Smaller By Weight	Size Inches	% Smaller By Weight	Size Inches	% Smaller By Weight
18	100	15	100	12	100
15	62-77	12	65-90	9	65-85
12	30-50	9	45-65	6	45-65
9	20-36	6	10-30	3	10-30
6	12-26	3	5-20	1 1/2	0-10
3	0-10	1 1/2	0-10		
Min. D_{50} =12"		Min. D_{50} =7.5"		Min. D_{50}=4.5"	

Riprap (RR) (Cont'd)

Sequence of Construction

Since riprap is used where erosion potential is high, construction must be sequenced so that the riprap is put in place with the minimum possible delay. Disturbance of areas where riprap is to be placed should be undertaken only when final preparation and placement of the riprap can follow immediately behind the initial disturbance. Where riprap is used for outlet protection, the riprap should be placed before or in conjunction with the construction of the pipe or channel so it is in place when the pipe or channel begins to operate.

Design Criteria

Gradation

The riprap shall be composed of a well-graded mixture down to the 1-inch size particle such that 50 percent of the mixture by weight shall be larger than the D_{50} size as determined from the design procedure. A well-graded mixture as used herein is defined as a mixture composed primarily of the larger stone sizes but with a sufficient mixture of other sizes to fill the progressively smaller voids between the stones.

The designer, after determining the riprap size that will be stable under the flow conditions, shall consider that size to be a minimum size and then, based on riprap gradations actually available in the area, select the size or sizes that equal or exceed the minimum size. The possibility of damage by children to riprap placement shall be considered in selecting a riprap size, especially if there is nearby water to toss the stones into.

Thickness

The minimum thickness of the riprap layer shall be 1.5 times the maximum stone diameter but not less than 6 inches.

Quality of Stone

Stone for riprap shall consists of field stone or rough unhewn quarry stone of approximately rectangular shape. The stone shall be hard and angular and of such quality that it will not disintegrate on exposure to water or weathering and it shall be suitable to all other respects for the purpose intended. The specific gravity of the individual stones shall be at least 2.5.

Riprap (RR) (Cont'd)

Rubble concrete may be used provided it has a density of at least 150 pounds per cubic foot and otherwise meets the requirements of this standard specification.

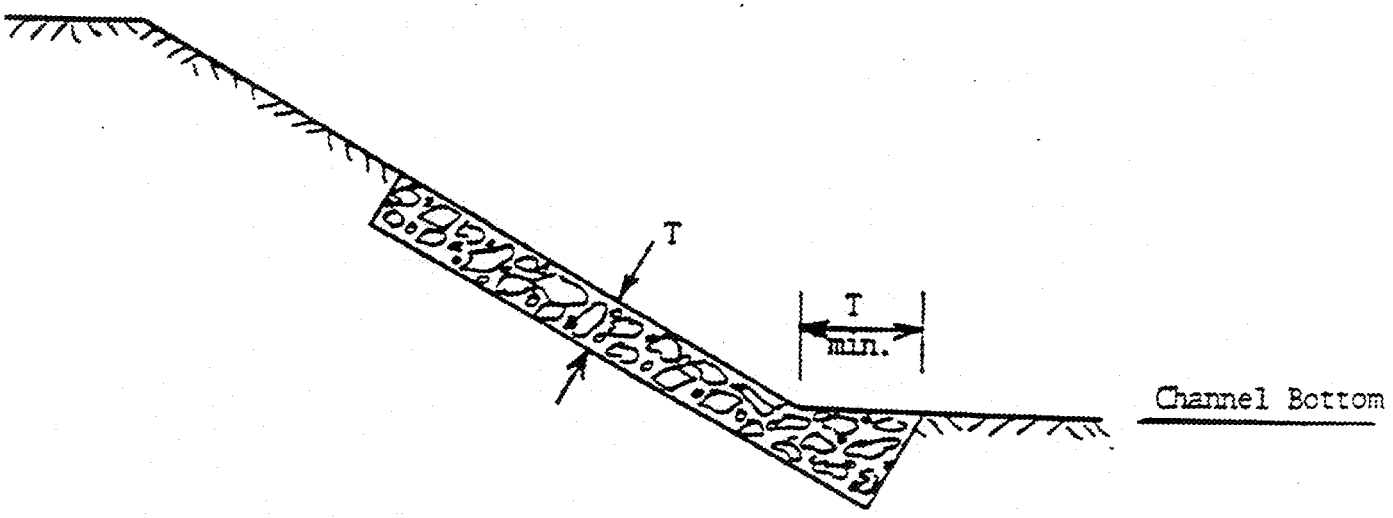
Riprap at Outlets

Design criteria for sizing the stone and determining the dimensions of riprap pads used at the outlet of drainage structures are contained in Standard and Specification, OUTLET PROTECTION.

Riprap for Channel Stabilization

For design of riprap lined channels, refer to the National Cooperative Highway Research Program Report No. 108, entitled "Tentative Design Procedure for Riprap-Lined Channels, " available from the Highway Research Board, National Academy of Science, 2101 Constitution Avenue, Washington, D.C. 20418. This is a procedure for determining a design stone size with a reasonable factor of safety such that the stone is stable under the design flow conditions. The design stone size used in this standard and specification is the D_{50} or median stone diameter that is defined as the stone size such that 50 percent of the mixture, by weight, is larger than that size. This riprap design procedure is given in Appendix F.

Where riprap is used only for bank protection and does not extend across the bottom of the channel, riprap shall be keyed into the bottom of the channel and shall extend across the bottom of the channel a minimum distance equal to the riprap layer thickness (T).



TOE REQUIREMENTS FOR RIPRAP BANK PROTECTION

Figure 1

Riprap (RR) (Cont'd)

Filter Blankets

A filter blanket is a layer of material placed between the riprap and the underlying soil surface to prevent soil movement into or through the riprap.

A filter blanket can be of two general forms: a gravel layer or a geotextile filter fabric. A determination of the need for a filter blanket is made by comparing particle sizes of the overlying material and the base material in accordance with the criteria below.

Gravel Filter Blanket: The following relationships must exist:

$$\frac{d_{15\ filter}}{d_{85\ base}} < 5 \qquad \frac{d_{15\ filter}}{d_{15\ base}} < 40$$

and,

$$\frac{d_{50\ filter}}{d_{50\ base}} < 40$$

In these relationships, filter refers to the overlying material and base refers to the underlying material. The relationships must hold between the filter material and the base material and between the riprap and the filter material. In some cases, more than one layer of filter material may be needed. Each layer of filter material should be approximately 6 inches thick.

Geotextile Filter Fabric: A geotextile filter fabric may be used in place of or in conjunction with gravel filters. The following particle size relationship must exist:

1. For a geotextile filter fabric adjacent to granular materials containing 50 percent or less (by weight) of fine particles (less than 0.074mm):

a) $\dfrac{d_{85\ base}\ (mm)}{EOS^{*}\ filter\ cloth\ (mm)} \geq 1$

b) Total open area of filter is less than 36 percent

Riprap (RR) (Cont'd)

2. For a geotextile filter fabric adjacent to all other soils:

   a) EOS* less than U.S. Standard Sieve No. 70.
   b) Total open area of filter is less than 10 percent.

No geotextile filter fabric should be used with less than 4 percent open area or an EOS* less than U.S. Standard Sieve No. 100.

* EOS - Equivalent Opening Size to a U.S. Standard Sieve Size.

Filter blankets should always be provided where seepage from underground sources threatens the stability of the riprap. No filter blanket is required for riprap used for storm drain outlet protection.

SPECIFICATIONS

Subgrade Preparation: The subgrade for the riprap or filter shall be prepared to the required lines and grades. Any fill required in the subgrade shall be compacted to a density approximating that of the surrounding undisturbed material. Brush, trees, stumps and other objectionable material shall be removed.

Filter Blanket: Placement of the filter blanket should be done immediately after slope preparation. For granular filters the stone should be spread in a uniform layer to the specified depth. Where more than one layer of filter material is used, the layers should be spread so that there is minimal mixing of the layers.

For a geotextile filter fabric, the fabric should be placed directly on the prepared slope. The edges of the sheets should overlap by at least 12 inches. Anchor pins, 15 inches long, should be spaced every 3 feet along the overlap. The upper and lower ends of the fabric should be buried a minimum of 12 inches deep. Care should be taken not to damage the fabric when placing the geotextile from a height greater than 3 feet. If damage occurs, that sheet should be removed and replaced. For large stone (12 inches or greater), a 4-inch layer of gravel may be necessary to prevent damage to the fabric.

Stone Placement: Placement of riprap should follow immediately after placement of the filter. The riprap should be placed so that it produces a dense well-graded mass of stone with a minimum of voids or gaps between the stones. The desired distribution of stones throughout the mass may be obtained by selective loading at the quarry, controlled dumping of successive loads during final placing, or by combination of these methods.

Riprap (RR) (Cont'd)

The riprap should be placed to its full thickness in one operation. The riprap should not be placed in layers. The riprap should not be placed by dumping into chutes or similar methods that are likely to cause segregation of the various stone sizes. Care should be taken not to dislodge the underlying material when placing the stones.

The finished slope should be free of pockets of small stone or clusters of large stones. Hand placing may be necessary to achieve the required grades and a good distribution of stone sizes. Final thickness of the riprap blanket should be within plus or minus 1/4 of the specified thickness.

Maintenance

Once a riprap installation has been completed, it should require very little maintenance. It should, however, be inspected periodically to determine if high flows have caused scour beneath the riprap or dislodged any of the stone. If repairs are needed, they should be accomplished immediately.

WATER MANAGEMENT, EROSION AND
SEDIMENT CONTROL FOR CONSTRUCTION AREAS

TECHNICAL STANDARD AND SPECIFICATIONS

Construction Road Stabilization (CRS)

Definition

The temporary stabilization of access roads, subdivision roads, parking areas, and other on-site vehicle transportation routes with stone immediately after grading.

Purpose

1. To reduce erosion from temporary roadbeds by construction traffic during wet weather.

2. To reduce the erosion and, therefore, regrading of permanent roadbeds between the time of initial grading and final stabilization.

Conditions Where Practice Applies

Wherever stone-base roads or parking areas are constructed, whether permanent or temporary, for use by construction traffic.

Planning Considerations

Areas that are graded for construction vehicle transport and parking purposes are especially susceptible to erosion. The exposed soil surface is continually disturbed, leaving no opportunity for vegetative stabilization. Such areas also tend to collect and transport runoff waters along their surfaces. During wet weather, they often become muddy and generate significant quantities of sediment that may pollute nearby streams or be transported off site on the wheels of construction vehicles. Dirt roads can become so unstable during wet weather that they are virtually unusable.

Immediate stabilization of such areas with stone may cost money at the outset, but it may actually save money in the long run by increasing the usefulness of the road during wet weather.

Permanent roads and parking areas should be paved as soon as possible after grading. However, it is understandable that funds for this purpose may not be available in the early phases of the development project. As an alternative, the early application of stone may solve potential erosion and stability problems and eliminate later regarding costs. Some of the stone will also probably remain in place for use as part of the final base course of the road.

Construction Road Stabilization (CRS) (Cont'd)

SPECIFICATIONS

Temporary Access Roads and Parking Areas

1. Temporary roads shall follow the contour of the natural terrain to the extent possible. Slopes should not exceed 10 percent.

2. Temporary parking areas should be located on naturally flat areas to minimize grading. Grades should be sufficient to provide drainage but should not exceed 4 percent.

3. Roadbeds shall be at least 14 feet wide for one-way traffic and 20 feet wide for two-way traffic.

4. All cuts and fills shall be 2:1 or flatter to the extent possible.

5. Drainage ditches shall be provided as needed.

6. The roadbed or parking surface shall be cleared of all vegetation, roots and other objectionable material.

7. A 6-inch course of Kentucky Department of Transportation (KDOT) No. 2 coarse aggregate shall be applied immediately after grading or the completion of utility installation within the right-of-way. Filter fabric may be applied to the roadbed for additional stability in accordance with fabric manufacturer's specifications.

Permanent Roads and Parking Areas

Permanent roads and parking areas shall be designed and constructed in accordance with applicable KDOT or local criteria except that an initial base course of gravel of at least 6 inches shall be applied immediately following grading.

Vegetation

All roadside ditches, cuts, fills and disturbed areas adjacent to parking areas and roads shall be stabilized with appropriate temporary or permanent vegetation according to the applicable standards and specifications contained in this handbook.

Construction Road Stabilization (CRS) (Cont'd)

Maintenance

Both temporary and permanent roads and parking areas may require periodic top dressing with new gravel. Seeded areas adjacent to the roads and parking areas should be checked periodically to ensure that a vigorous stand of vegetation is maintained. Roadside ditches and other drainage structures should be checked regularly to ensure that they do not have silt or other debris that reduces their effectiveness.

WATER MANAGEMENT, EROSION AND
SEDIMENT CONTROL FOR CONSTRUCTION AREAS

TECHNICAL STANDARD AND SPECIFICATIONS

Construction Entrance (CE)

Definition

A stone stabilized pad located at points of vehicular entrances and/or exits on a construction site.

Purpose

To reduce the amount of sediment transported onto public roads by motor vehicles or runoff.

Conditions Where Practice Applies

Wherever traffic leaves a construction site and moves directly onto a public road or other paved area.

Planning Considerations

Construction entrances provide an area where mud can be removed from construction vehicle tires before they enter a public road. If the action of the vehicle traveling over the gravel pad is not sufficient to remove the majority of the mud, then the tires must be washed before the vehicle enters a public road. If washing is used, provisions must be made to intercept the wash water and trap the sediment before it is carried off-site. Construction entrances should be used in conjunction with the stabilization of construction roads to reduce the amount of mud picked up by construction vehicles.

Design Criteria

1. Aggregate Size

   DOT aggregate No. 2 (1.5 - 3.0 in. stone) should be used.

2. Entrance Dimensions

   The aggregate layer must be at least 6 inches thick. It must extend the full width of the vehicular entrance and exit area. The length of the entrance must be at least 50 feet.

Construction Entrance (CE) (Cont'd)

Design Criteria (Cont'd)

3. Washing

If conditions on the site are such that the majority of the mud is not removed by the vehicles traveling over the gravel, then the tires of the vehicles must be washed before entering a public road. Wash water must be carried away from the entrance to a settling area to remove sediment. A wash rack may also be used to make washing more convenient and effective.

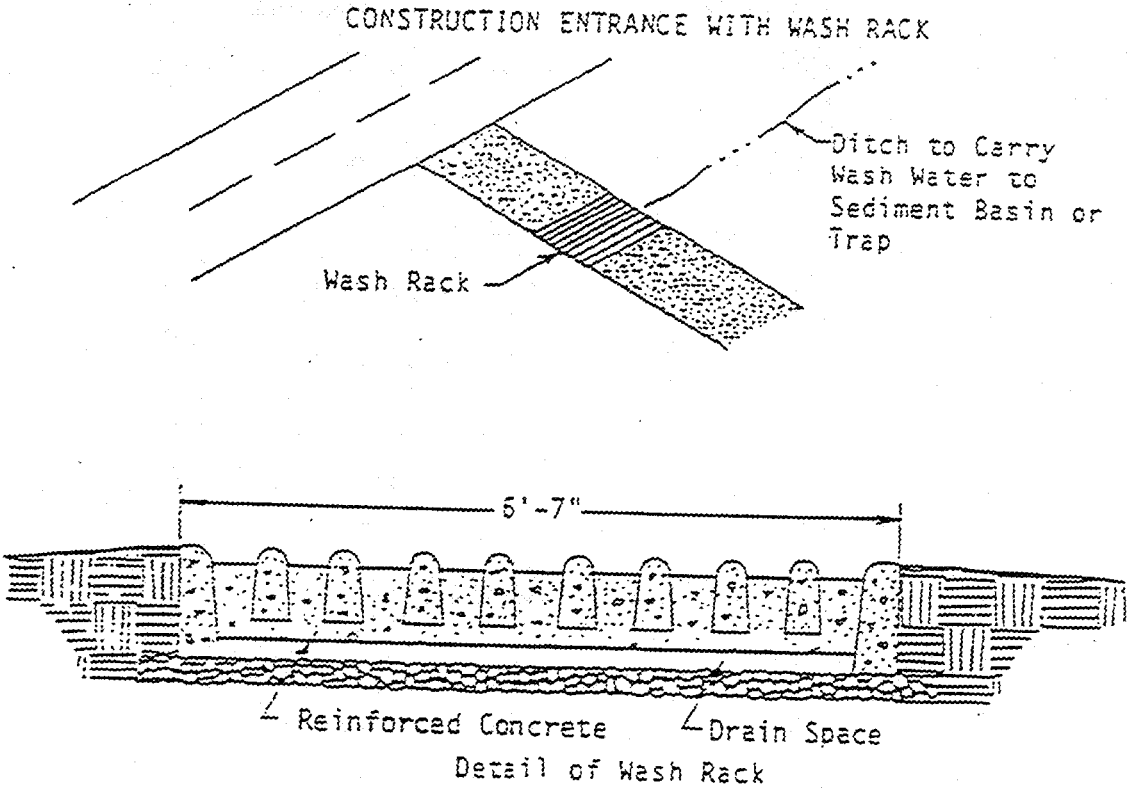


Figure 1

4. Location

The entrance should be located to provide for maximum utility by all construction vehicles.

Construction Entrance (CE) (Cont'd)

SPECIFICATIONS

Plans for constructing and installing the construction entrance shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve the intended purpose.

Specifications for installing the construction entrance shall use or be in conformance with the following. Any variation from these specifications shall be approved by an engineer.

1. Placement

   The area of the entrance shall be cleared of all vegetation, roots and other objectionable material. The gravel shall be placed to the specified dimensions. Any drainage facilities required because of washing should be constructed according to specifications. If wash racks are used, they should be installed according to manufacturer's specifications.

2. Maintenance

   The entrance shall be maintained in a condition that will prevent tracking or flow of mud onto public rights-of-way. This may require periodic top dressing with 2-inch stone, as conditions demand, and repair and/or cleanout of any structures used to trap sediment. All materials spilled, dropped, washed, or tracked from vehicles onto roadways or into storm drains must be removed immediately.

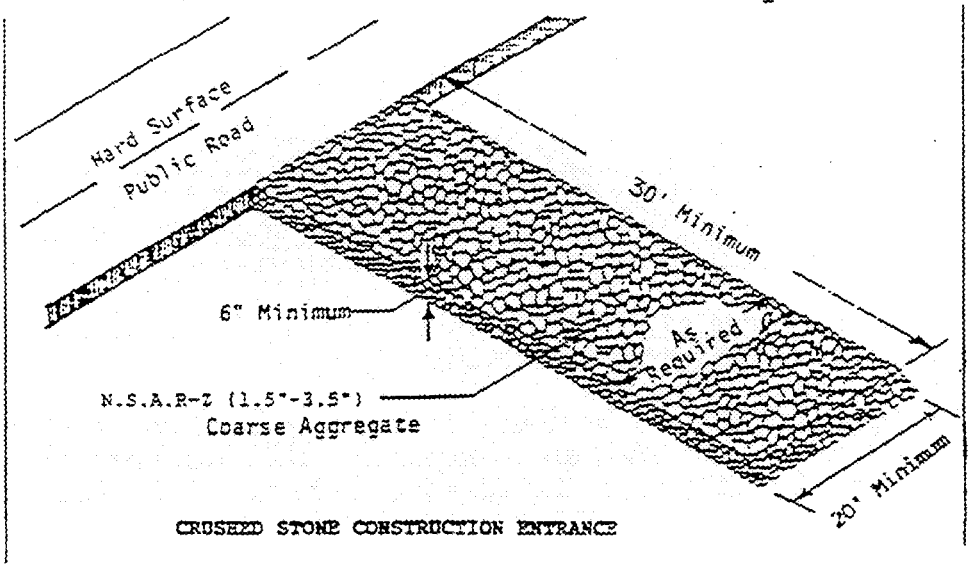


Figure 2

WATER MANAGEMENT, EROSION AND
SEDIMENT CONTROL FOR CONSTRUCTION AREAS

TECHNICAL STANDARD AND SPECIFICATION

Landing Grading (LG)

Definition

Reshaping by grading the ground surface to planned elevations and/or slopes that are determined by engineering survey and layout.

Purpose

The practice is for one or more of the following: Provide more suitable sites for buildings, facilities and other land uses; improve surface drainage; and control erosion.

Conditions Where Practice Applies

The practice is applicable where grading to planned elevations is practical.

Planning Criteria

The grading plan and installation shall be based upon adequate surveys and investigations. The plan is to show the location, slope, cut, fill, and finish elevation of the surfaces to be graded and the auxiliary practices for proper disposal of runoff water, slope stabilization, erosion control and drainage such as waterways, lined ditches, diversions, grade stabilization structures, retaining walls, and surface and subsurface drains.

The development and establishment of the plan shall include the following:

1. The cut face of the earth excavation that is to be vegetated shall not be steeper than two horizontal to one vertical. Cut slopes of areas not to be vegetated shall be at the safe angle of repose for the materials encountered.

2. The permanent exposed faces of fills shall be no steeper than two horizontal to one vertical.

3. Provisions are to be made to safely conduct surface water to storm drains or suitable natural water courses and to prevent surface runoff from damaging cut faces and fill slopes.

Landing Grading (LG) (Cont'd)

4. Subsurface drainage is to be provided (1) in areas having high water table, or (2) to intercept seepage that would affect slope stability, building foundations or create undesirable wetness.

5. Excavations shall not be made so close to property lines as to endanger adjoining property without supporting and protecting such property from erosion, sliding, settling or cracking.

6. No fill is to be placed where it will slide or wash upon the premises or another, or so placed adjacent to the bank or a channel as to create bank failure or reduce the natural capacity of the stream.

7. Fills are to consist of material from cut areas, borrow pits, or other approved sources.

SPECIFICATIONS

Timber, logs, brush, rubbish, and vegetative matter that will interfere with the grading operation or affect the planned stability of fill areas shall be removed and disposed of according to the design.

Topsoil is to be stripped and stockpiled in amounts necessary to completely finish grading of all exposed areas requiring topsoil for the establishment of vegetation.

Fill material is to be free of brush, rubbish, rocks, logs, and stumps in amounts that will be detrimental to constructing stable fills.

Cut slopes that are to be topsoiled will be scarified to a minimum depth of three inches prior to placement of topsoil.

Unless otherwise regulated by stricter controls of local building codes, all fills intended to support buildings, structures, sewers and conduits are to be compacted to a minimum of 90 percent of standard proctor with proper moisture control. Compaction of other fills will be as required to reduce slipping, erosion or excess saturation.

Landing Grading (LG) (Cont'd)

Frozen materials or soft, mucky or easily compressible materials are not to be incorporated in fills intended to support buildings, parking lots, roads, structures, sewers or conduits.

Maximum thickness of layers of fills to be compacted are not to exceed 8 inches.

All areas are to be rough graded to within 0.2 foot of the planned elevation after allowance has been made for thickness of topsoil, paving or other installations.

All disturbed areas shall be left with a neat and finished appearance.

Seeding, fertilizing, mulching, and sodding shall be in accordance with applicable standards in this handbook.

WATER MANAGEMENT, EROSION AND
SEDIMENT CONTROL FOR CONSTRUCTION AREAS

TECHNICAL STANDARD AND SPECIFICATIONS

Topsoiling (T)

Definition

Salvaging, storing, protecting and using topsoil to enhance final site stabilization with vegetation.

Purpose

To provide a suitable growth medium for vegetation.

Conditions Where Practice Applies

Where a sufficient supply of quality topsoil is available.

Where the subsoil or areas of existing surface soil present the following problems:

1. The structure, Ph, or nutrient balance of the available soil cannot be amended by reasonable means to provide an adequate growth medium for the desired vegetation.

2. The soil is too shallow to provide adequate rooting depth or will not supply necessary moisture and nutrients for growth of desired vegetation.

3. The soil contains substances toxic to the desired vegetation.

Where high-quality turf or ornamental plants are desired.

Where slopes are 2:1 or less.

Planning Considerations

Topsoil is the surface layer of the soil profile, generally characterized as darker than the subsoil due to enrichment with organic matter. It is the major zone of root development and biological activity. Microorganisms that enhance plant growth thrive in this layer. Topsoil can usually be differentiated from subsoil by texture as well as color. Clay content usually increases in the subsoil. Where subsoils are often high in clay, the topsoil layer may be significantly coarser in texture. The depth of topsoil may be quite variable. On severely eroded sites it may be gone entirely.

Topsoiling (T) (Cont'd)

Advantages of topsoil include its high organic-matter content and friable consistence (soil aggregates can be crushed with only moderate pressure), and its available water-holding capacity and nutrient content. Most often it is superior to subsoil in these characteristics. The texture and friability of topsoil are usually much better to the seed emerging and root growth.

In addition to being a better growth medium, topsoil is often less erodible than subsoils, and the coarser texture of topsoil increases infiltration capacity and reduces runoff.

Although topsoil may provide an improved growth medium, there may be disadvantages, too. Stripping, stockpiling, hauling, and spreading topsoil, or importing topsoil may not be cost effective. Handling may be difficult if large amounts of branches or rocks are present, or if the terrain is too rough. Most topsoil contains weed seeds, that compete with desirable species.

In site planning, compare the options of topsoiling with preparing a seedbed in the available subsoil. The clay content of many subsoils retains moisture. When properly limed and fertilized, subsoils may provide a satisfactory growth medium, that is generally free of weed seeds.

Topsoiling is normally recommended where ornamental plants or high-maintenance turf will be grown. It may also be required to establish vegetation on shallow soils, soils containing potentially toxic materials, stony soils, and soils of critically low Ph (high acidity).

If topsoiling is to be used, consider the following:

1. quality and amount of topsoil available and needed,

2. location for a stabilized stockpile that will not erode, block drainage, or interfere with work on the site.

Bonding--if topsoil and subsoil are not properly bonded, water will not infiltrate the soil profile evenly, and it will be difficult to establish vegetation.

Do not apply topsoil to slopes steeper than 2:1 to avoid slippage, or to a subsoil of highly contrasting texture. Sandy topsoil over clay subsoil is a particularly poor combination especially on steep slope. Water may creep along the junction between the soil layers and cause the topsoil to slough.

Topsoiling (T) (Cont'd)

SPECIFICATIONS

Plans for installing land grading shall describe the requirements for applying this practice to achieve the intended purpose.

1. Materials - Quality topsoil has the following characteristics:

   a. Texture--loam, sandy loam, and silt loam are best; sandy clay loam, silty clay loam, clay loam, and loamy sand are fair. Do not use heavy clay and organic soils such as peat or muck as topsoil.

   b. Organic matter content--(sometimes referred to as "humic matter") should be greater than 1 percent by weight.

   c. Acidity--Ph should be greater than 3.6 before liming, and liming is required if pH is less than 6.0.

The depth of material meeting the above qualifications should be at least 2 inches. Soil factors such as rock fragments, slope, depth to water table, and layer thickness affect the ease of excavation and spreading of topsoil.

Generally, the upper part of the soil, that is richest in organic matter, is most desirable; however, material excavated from deeper layers may be worth storing if it meets the other criteria listed above.

Organic soils such as mucks and peats do not make good topsoil. They can be identified by their extremely light weight when dry.

2. Stripping - Strip topsoil only from those areas that will be disturbed by excavation, filling, roadbuilding, or compaction by equipment. A 4-6 inch stripping depth is common, but depth varies depending on the site. Determine depth of stripping by taking soil cores at several locations within each area to be stripped. Topsoil depth generally varies along a gradient from hilltop to toe of slope. Put sediment basins, diversions, and other controls into place before stripping.

Topsoiling (T) (Cont'd)

3. Stockpiling - Select stockpile location to avoid slopes, flood plains and natural drainageways (place away from water bodies to prevent sedimentation), and traffic routes. On large site, respreading is easier and more economical when topsoil is stockpiled in small piles located near areas where they will be used.

   Sediment barriers--Use sediment fences or other barriers where necessary to retain sediment.

   Temporary seeding--Protect topsoil stockpiles by temporarily seeding as soon as possible, no more than 30 days after the formation of the stockpile.

   Permanent vegetation-- If stockpiles will not be used within 12 months, they must be stabilized with permanent vegetation to control erosion and weed growth.

4. Site Preparation - Before spreading topsoil, establish erosion and sedimentation control practices such as diversions, berms, dikes, waterways, and/or sediment basins.

   Grading--Maintain grades on the areas to be topsoiled according to the approved plan. Adjust grades and elevations for receipt of topsoil.

   Liming of Subsoil--Where the Ph of the existing subsoil is 6.0 or less or the soil is composed of heavy clays, incorporate agricultural limestone in amounts recommended by soil tests or specified for the seeding mixture to be used (see Permanent Seeding BMP). Incorporate lime to a depth of at least 2 inches by disking.

   Roughening--Immediately prior to spreading the topsoil, loosen the subgrade by disking or scarifying to a depth of at least 4 inches to ensure bonding of the topsoil and subsoil. If no amendments have been incorporated, loosen the soil to a depth of at least 6 inches before spreading topsoil.

5. Spreading Topsoil

   Uniformly distribute topsoil to a minimum compact depth of 2 inches on 3:1 slopes and 4 inches on flatter slopes. To determine the volume of topsoil required for application to various depths, use Table 1. Do not spread topsoil while it is frozen or muddy or when the subgrade is wet or frozen.

Topsoiling (T) (Cont'd)

Correct any irregularities in the surface that result from topsoiling or other operations to prevent the formation of depressions or water pockets.

Compact the topsoil enough to ensure good contact with the underlying soil, but avoid excessive compaction as it increases runoff and inhibits seed germination. Light packing with a roller is recommended where high-maintenance turf is to be established.

Table 1 - Cubic Yards of Topsoil Required for Application to Various Depths.

Depth (Inches)	Cu Yds Per 1,000 Sq. ft.	Cu Yds Per Acre
1	3.1	134
2	6.2	268
3	9.3	403
4	12.4	536
5	15.5	670
6	18.6	804

On slopes and areas that will not be mowed, the surface may be left rough after spreading topsoil. A disk may be used to promote bonding at the interface between the topsoil and subsoil.

After topsoil application, follow procedures for temporary or permanent seeding, taking care to avoid excessive mixing of topsoil into the subsoil.

WATER MANAGEMENT, EROSION AND
SEDIMENT CONTROL FOR CONSTRUCTION AREAS

TECHNICAL STANDARD AND SPECIFICATION

Dust and Pollutant Control (DPC)

Definition

Reducing surface and air movement of dust and other pollutants during land disturbing, demolition, and other construction activities.

Purpose

To prevent surface and groundwater contamination and air movement of dust and other pollutants from exposed surfaces and to reduce the presence of airborne substances that may be harmful or injurious to human health, welfare, and safety, or to animals and plant life.

Conditions Where Practice Applies

This practice is applicable to areas subject to surface and air movement of dust where, without treatment, on-site and off-site damage may occur and to heavy use areas on the construction site.

Planning Considerations

Earthmoving activities cause the largest amount of construction dust emissions, although traffic and general disturbance of the soil can also generate a significant amount of dust. The less soil exposed at one time, the less potential for dust generation. Therefore, dust control should involve phasing of construction activities and utilizing temporary stabilization measures upon completion of grading.

Oil, gasoline, grease, solvents and other pollutants are associated with equipment used on construction sites. The level of equipment maintenance and repair will, of course, depend upon the size and complexity of the project. But whenever equipment must be serviced, special precautions should be taken.

SPECIFICATIONS

Methods and Materials: Blowing dust may be controlled permanently or temporarily, depending on the needs of the site.

Dust and Pollutant Control (DPC) (Cont'd)

Temporary Practices

Mulching: Chemical mulch binders may be used instead of asphalt to bind mulch materials. Binders such as Curasol or Tenatack should be used according to manufacturer's recommendations. Refer to the Mulching section of this manual.

Vegetative Cover: Refer to Temporary Seeding.

Spray-on-Adhesive: These are used on mineral soils (not effective on muck soils); traffic should be kept off the area. Apply under proper weather conditions according to manufacturer's directions. See chart below for application rates.

SPRAY-ON ADHESIVE SPECIFICATION

Adhesive	Water Dilution	Type Nozzle	Application Rate (Gallons/Acre)
Anionic Asphalt Emulsion	7:1	Coarse Spray	1,200
Lates Emulsion	12 1/2:1	Fine Spray	235
Resin-in-water Emulsion	4:1	Fine Spray	300

Tillage: This practice is designed to roughen and bring clods to the surface. It is an emergency measure that should be used before wind erosion starts. Begin plowing on windward side of site. Chisel-type plows spaced about 12 inches apart, spring-toothed harrows, and similar plows are examples of equipment that may produce the desired effect.

Irrigation: This is generally done as an emergency treatment. Site is sprinkled with water until the surface is wet. Repeat as needed.

Barriers: Solid board fences, burlap fences, crate walls, bales of hay and similar materials may be used to control air currents and soil blowing, if they are a problem.

Calcium Chloride: Apply at rate that will keep soil surface moist. May need retreatment.

Dust and Pollutant Control (DPC) (Cont'd)

Permanent Practices

Permanent Vegetation: Existing trees and large shrubs may afford valuable protection if left in place. Also refer to Permanent Seeding section of this document.

Topsoiling: This entails covering the surface with less erosive soil material. Refer to section in this document on Topsoiling.

Stone: Cover surface with crushed stone or coarse gravel.

Maintenance and repair of equipment should be confined to areas specifically designed for that purpose. These areas should have adequate waste disposal receptacles for liquid as well as solid waste. If possible, take waste oil to designated waste oil collection areas for recycling. On construction sites where designed areas for equipment servicing is not feasible, special care should be taken to assure that potential pollutants cannot be washed into nearby receiving streams or sewers.

Adequate sanitary facilities, such as chemical toilets, should be placed near maintenance areas or other convenient sites on the construction area.

Scrap from maintenance and other construction litter should be placed in containers or otherwise disposed of properly.

Maintenance areas should be inspected and cleaned daily.